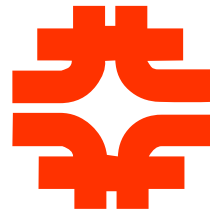
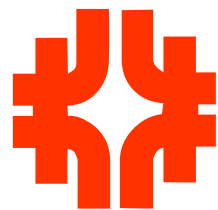


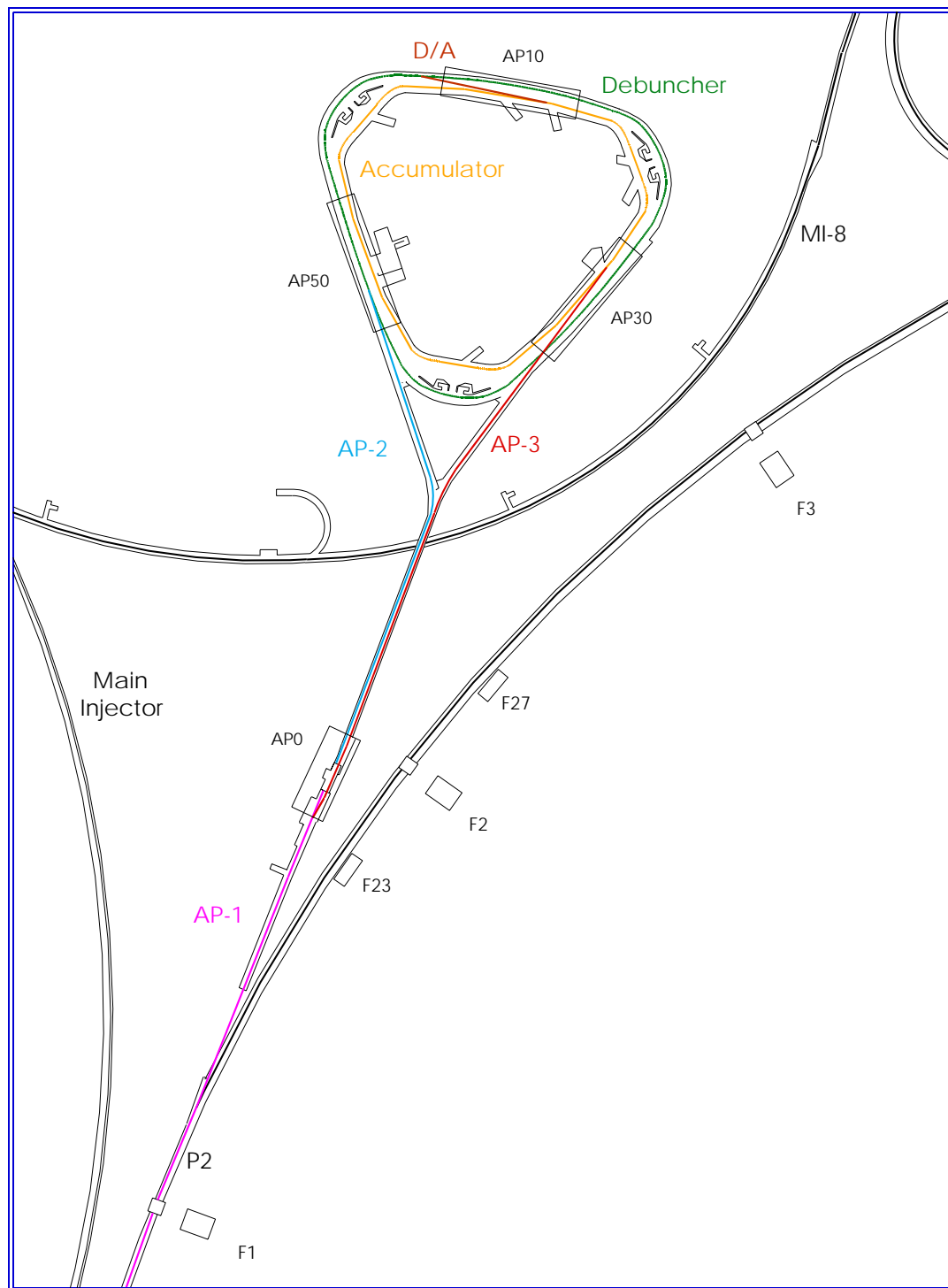
Pbar Source Performance and Plans

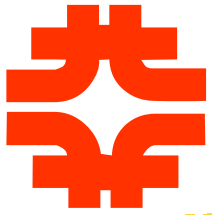


Dave McGinnis
AAC Meeting
December 12, 2001



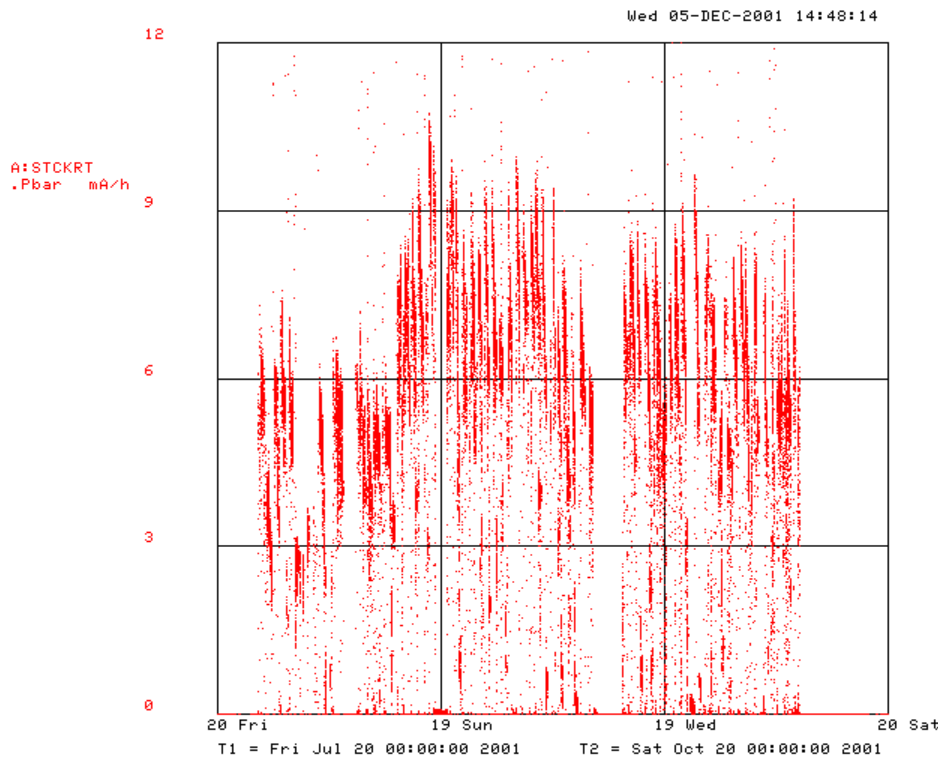
Pbar Source





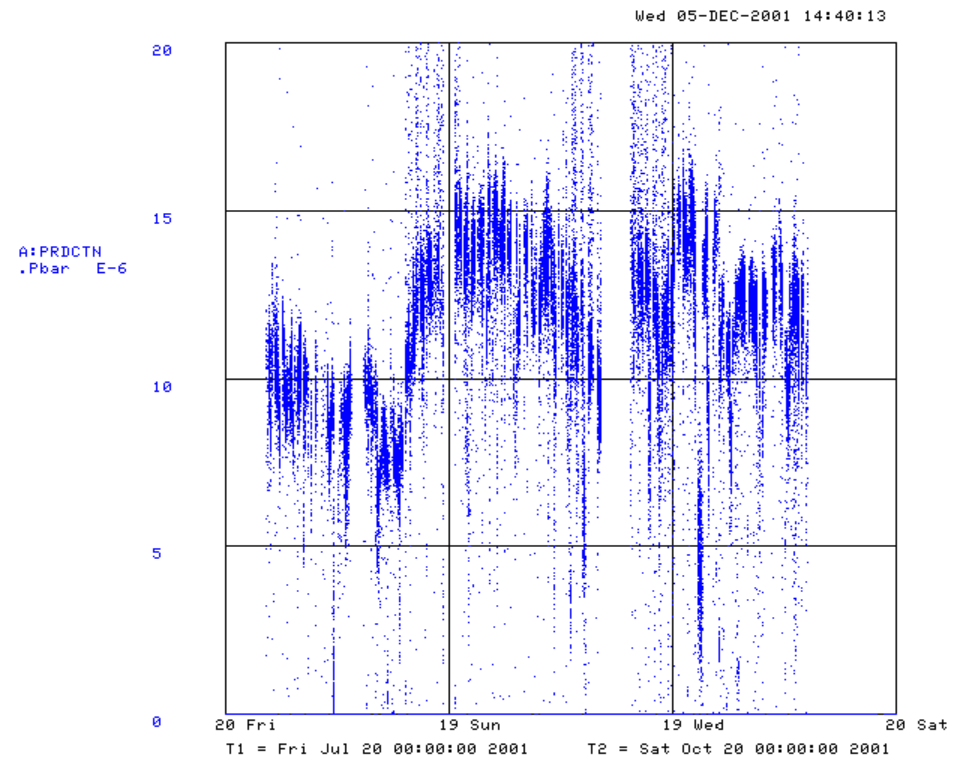
Pbar Stacking Rate

Stacking Rate

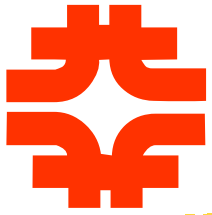


- Best Stack Rate 10.2×10^{10} /hour
- Stack Rate Goal 20×10^{10} /hour

Production Efficiency

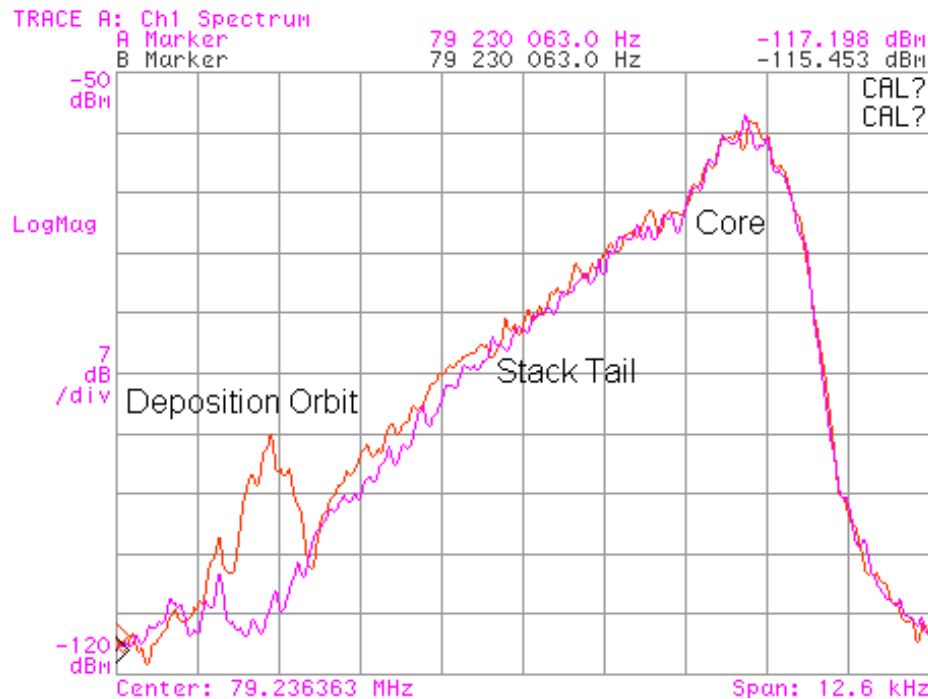


- Production is low by 20%
 - AP2 & Debuncher Aperture
- Cycle Time is slow
 - Design 1.5 sec
 - Operational 2.4 sec.

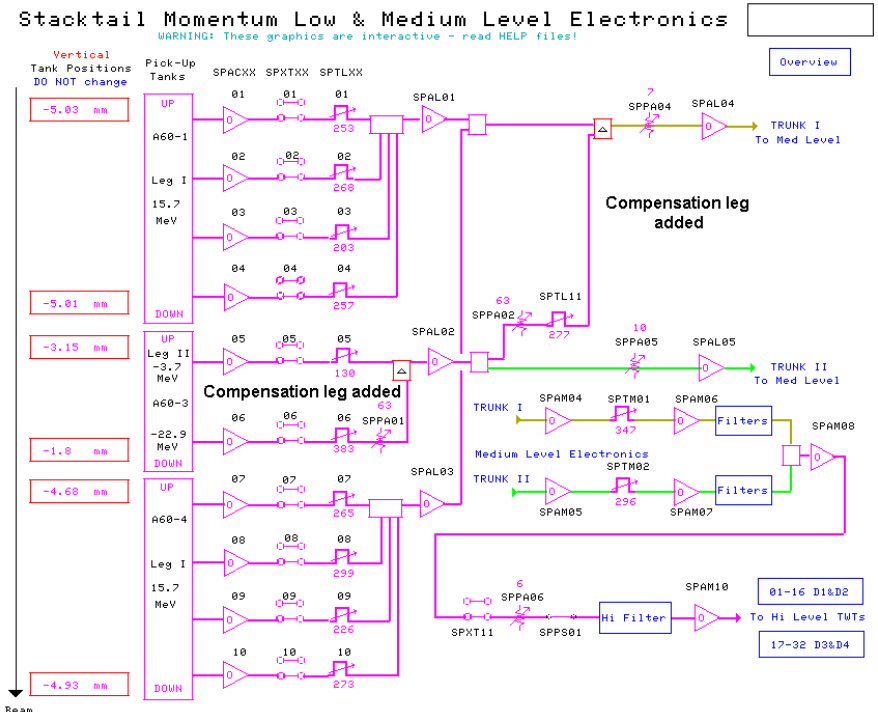


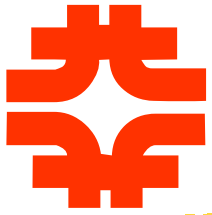
Why is the Cycle Time so Slow?

Accumulator Longitudinal Spectrum



Stacktail Cooling Electronics

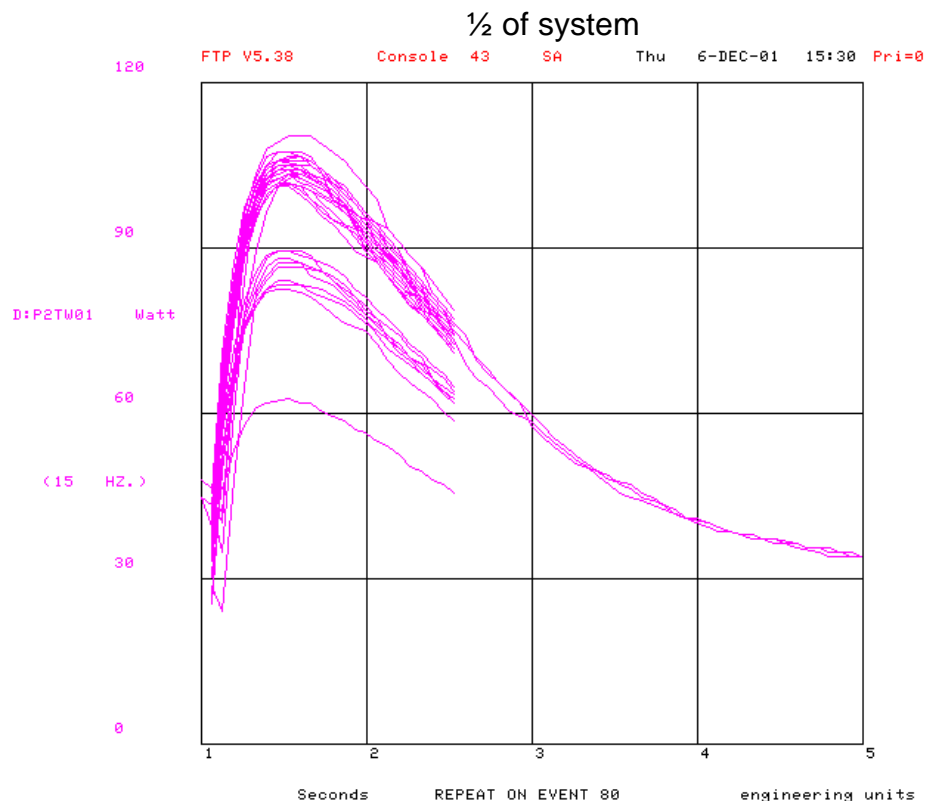




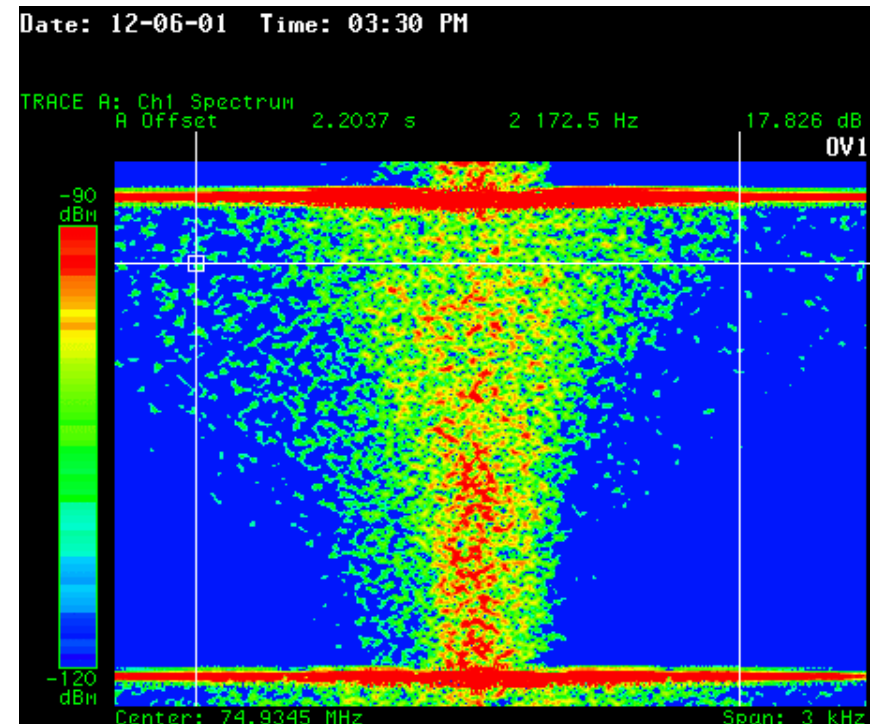
Why is the Cycle Time so Slow?

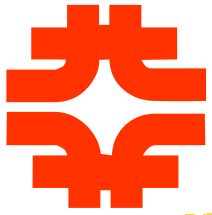
- For a given Stacktail gain, the larger the momentum spread of the injected pulse, the longer it takes to clear the pulse from the Stacktail Deposition orbit.
 - The momentum spread coming from the Debuncher is too large. Debuncher Momentum cooling is much slower than design.

Debuncher TWT power vs time



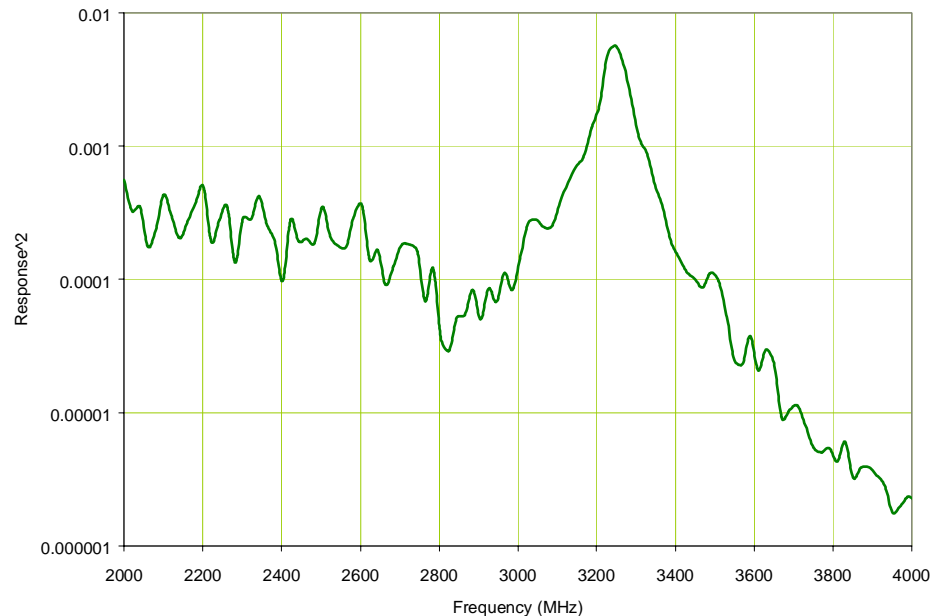
Debuncher Longitudinal Spectrum vs time





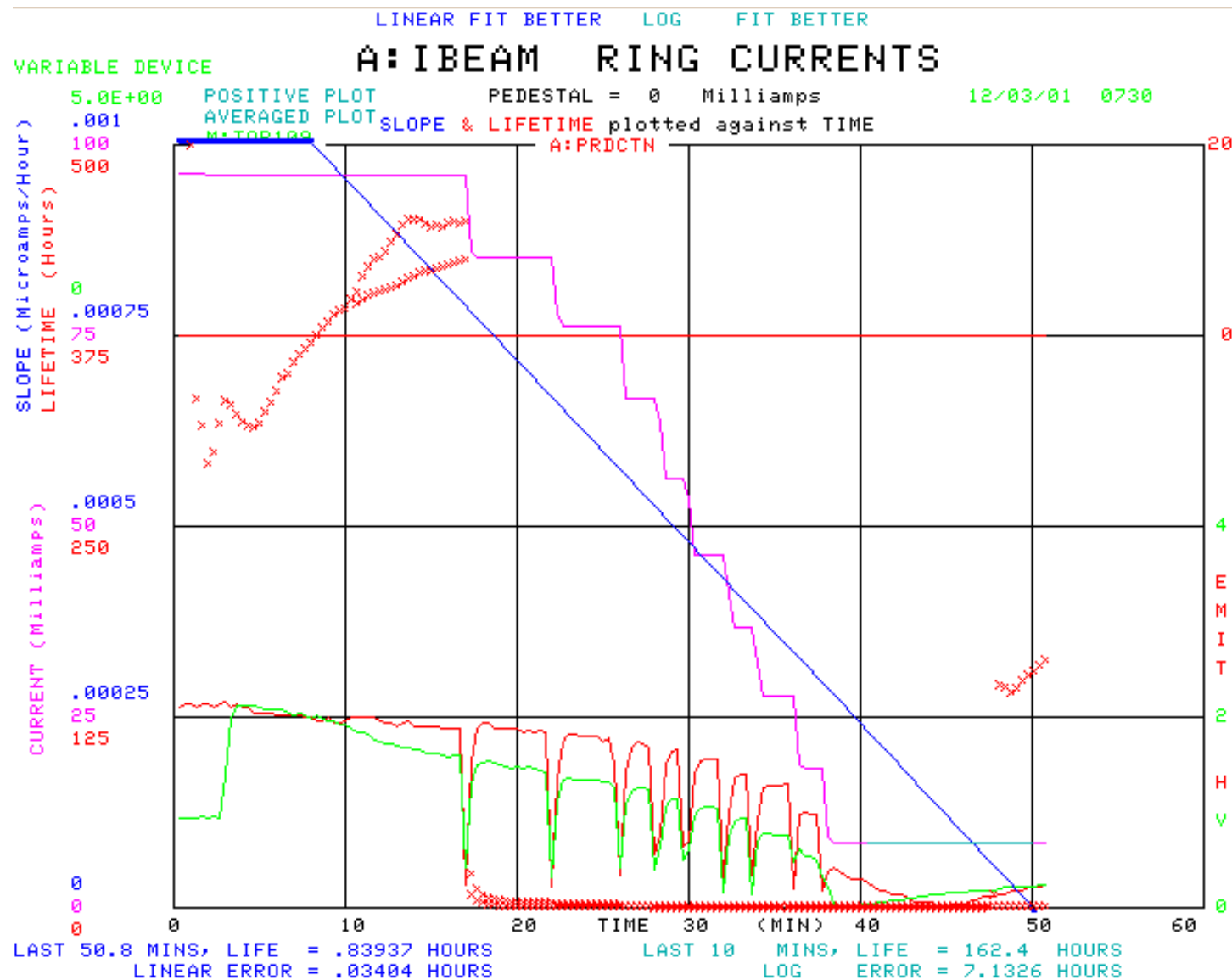
Stacktail Heating of the Core

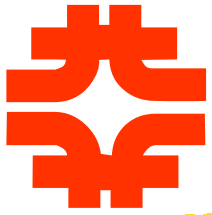
- For a faster rep. rate, the Stacktail gain must be increased to move the beam off the deposition orbit faster.
- The StackTail kickers have a certain amount transverse kick due to imperfections.
- This kick will heat the Accumulator core and must be compensated
 - In Run I, these kicks were wideband and compensated with wideband transverse “delta” kickers
 - In Run 2, this transverse kick is dominated by a microwave mode at 3.2 GHz with a Q of 50.



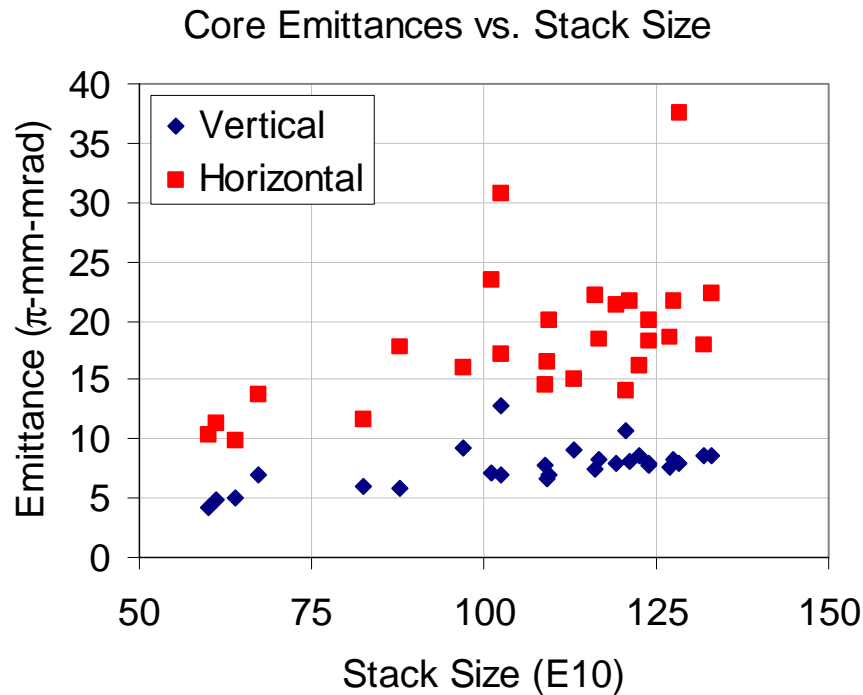


Pbar Transfers to the Collider

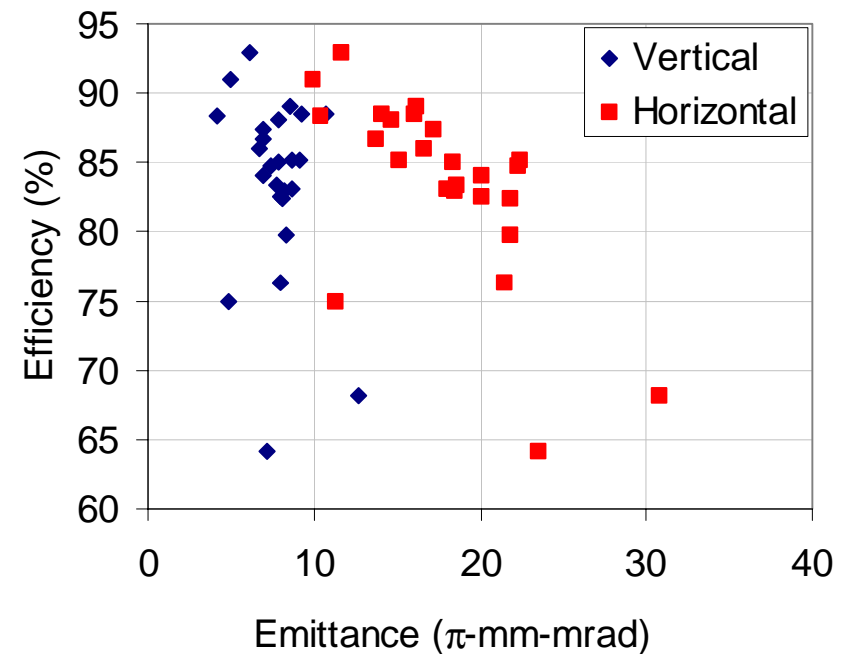




Pbar Transfers to the Collider



Accumulator to MI Efficiency vs. Core Emittances

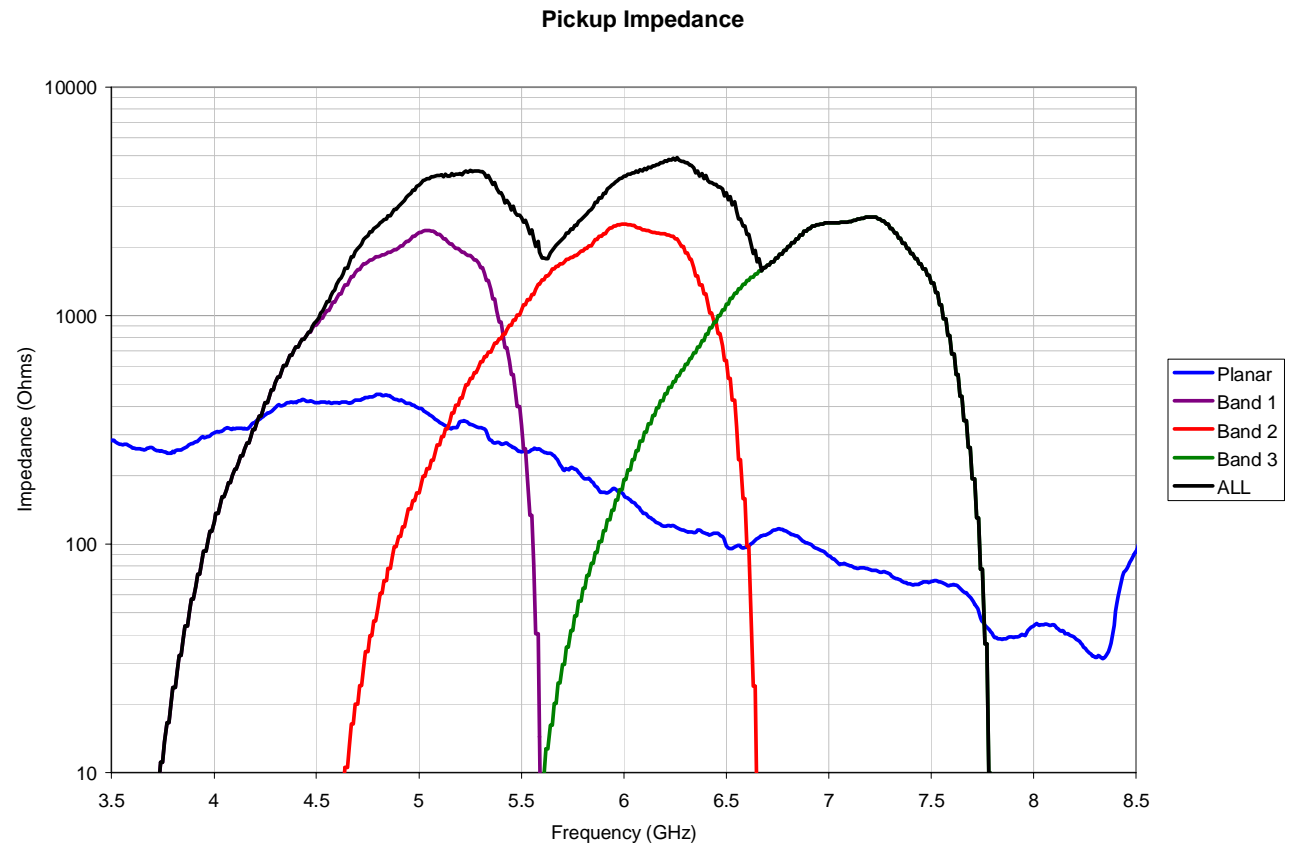


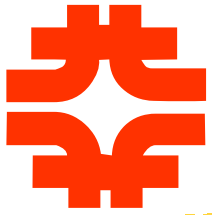
- Transverse emittance is too big for the collider
 - Transverse cooling is less effective in Run IIa than Run Ib because of η change
 - Heating Sources?



Accumulator Core Cooling Upgrade

- Present system consists of a 2-4 GHz band and a 4-6 GHz band
 - The 2-4 GHz band is ineffective because of the small value of η
 - The 4-6 GHz band suffers from poor signal to noise.
- Replace both core bands with a 3 band Debuncher style system
 - Better sensitivity
 - Better mixing factor
 - Installed by June 2002

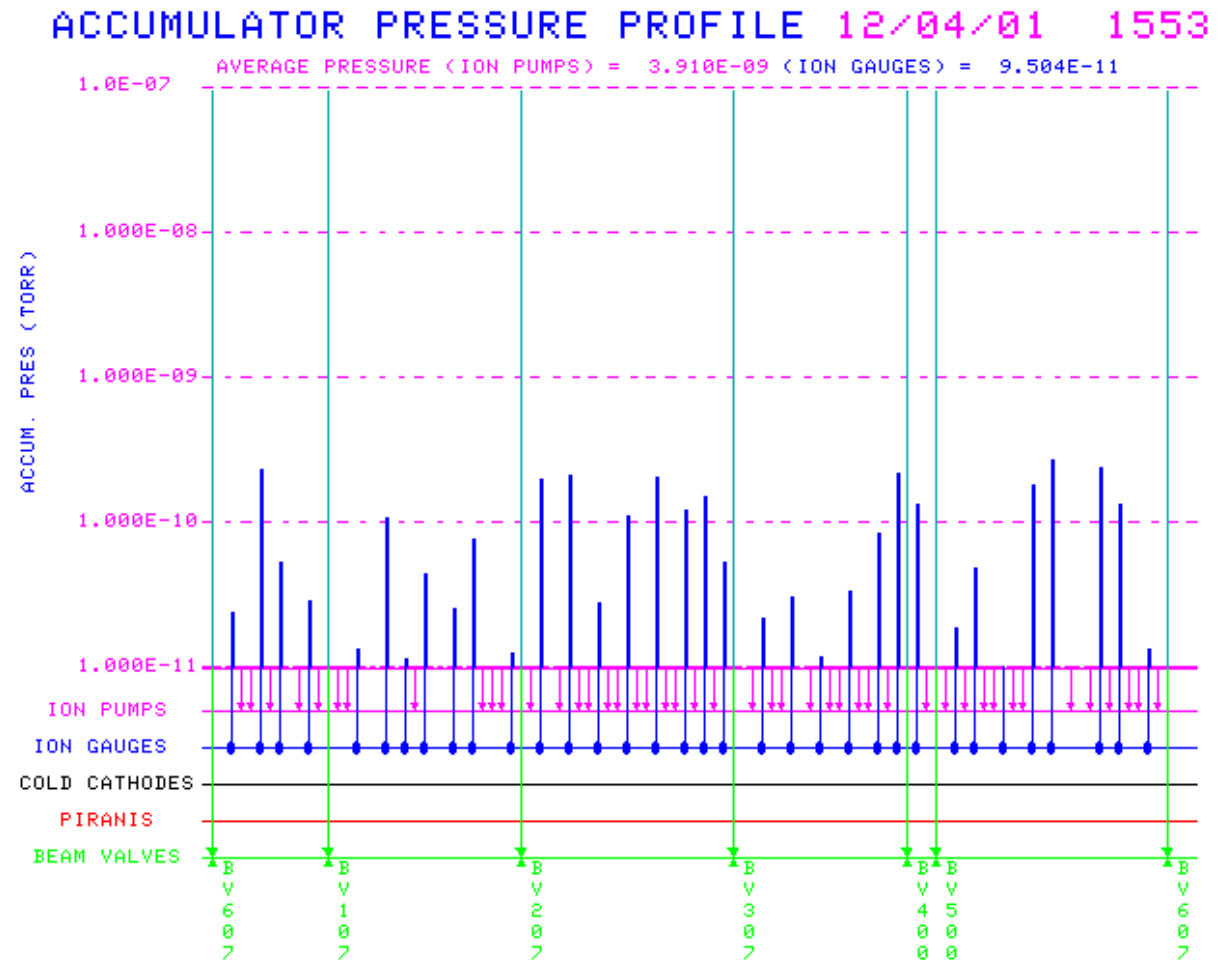


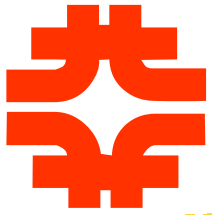


Transverse Heating Sources

- A 10^{-9} torr Vacuum leak was found and repaired during the last shutdown

- Beam lifetime on the core orbit went from 250 hours to over 800 hours.
- Beam emittance unaffected by lifetime increase.

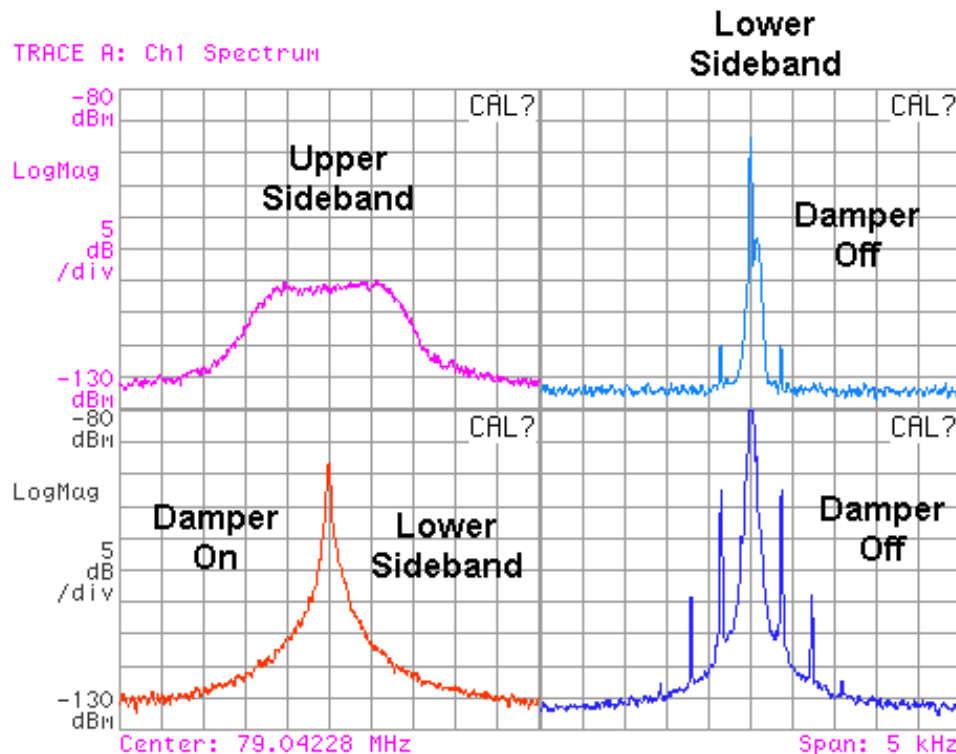




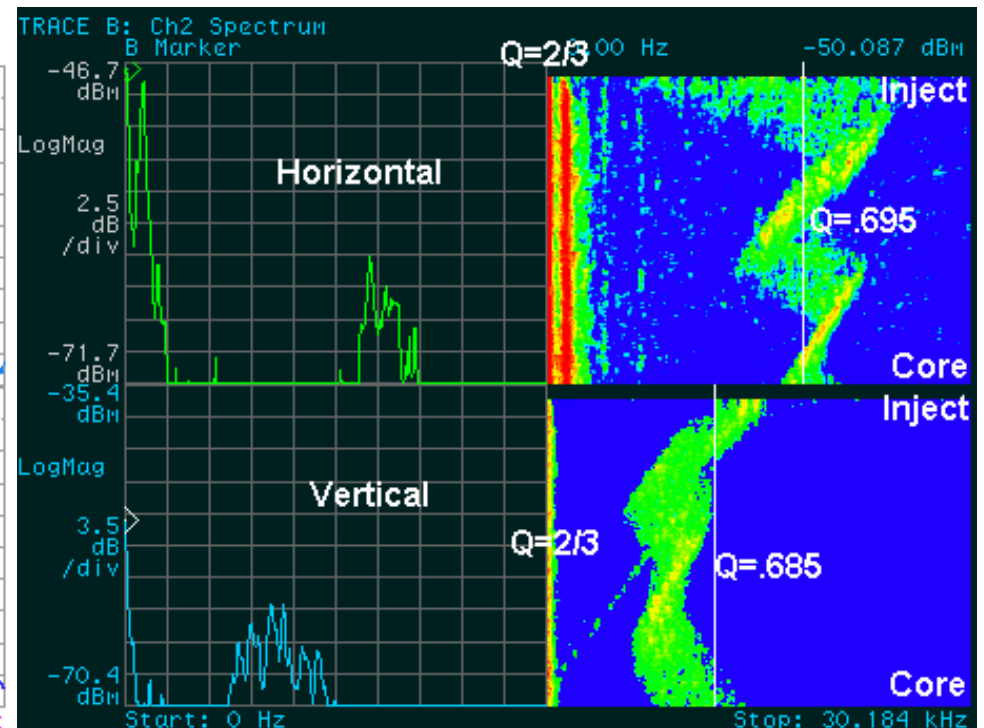
Transverse Heating Sources

- Core beam on the edge of stability because of the “local” chromaticity at the core.
 - ❑ Sextupoles and octupoles set to keep tune constant across the large momentum aperture of the Accumulator
 - ❑ Large damper gains are needed to keep beam stable.

Accumulator Core Vertical Schottky Spectrum



Tune across Accumulator Momentum Aperture





Longitudinal Emittance during Transfers to the Collider

- Run Ib – Constant Bucket Method

- 6 Transfers, 1 bunch per transfer,

- Constant bucket area

- Stack Dilution causes intensity per bunch to drop for subsequent transfers

- 50% of stack removed

- Run IIa – Momentum Squaring Method

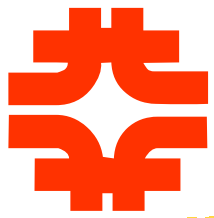
- Goal to get same intensity and longitudinal emittance for each transfer

- 9 transfers, 4 bunches per transfer

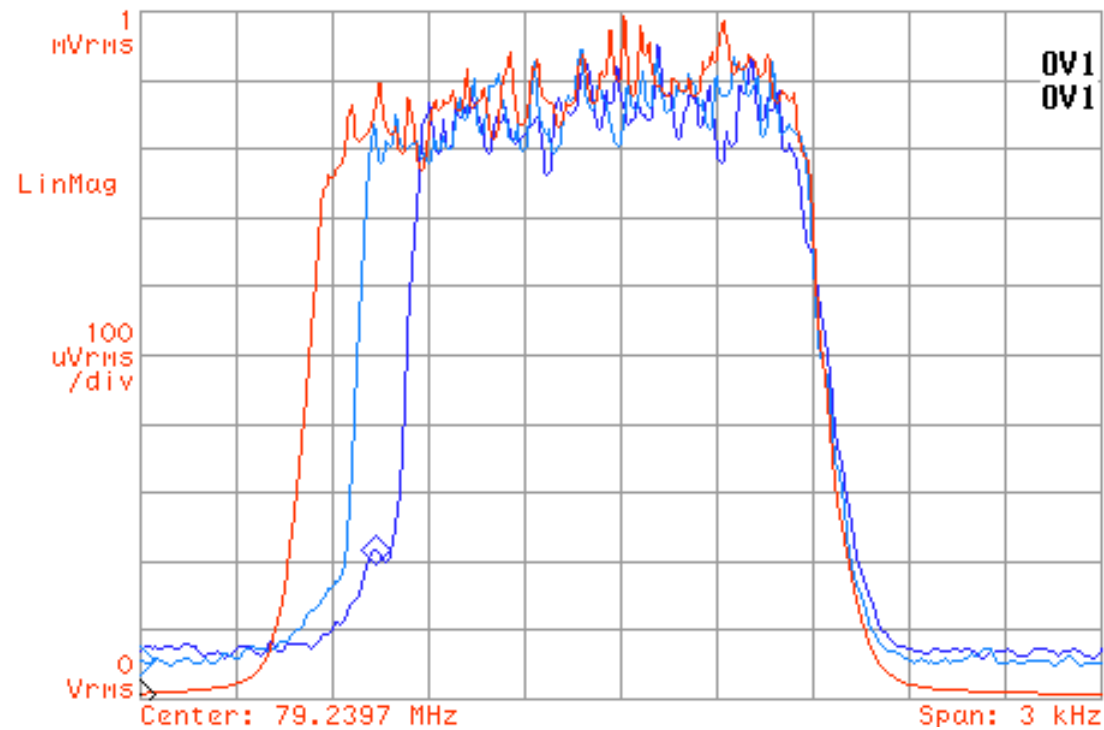
- 90% of stack removed

- Very sensitive to delay between transfers

- Momentum distribution dilutes or rounds off during waiting period between transfers



Core Longitudinal Profile during Transfers to the Collider



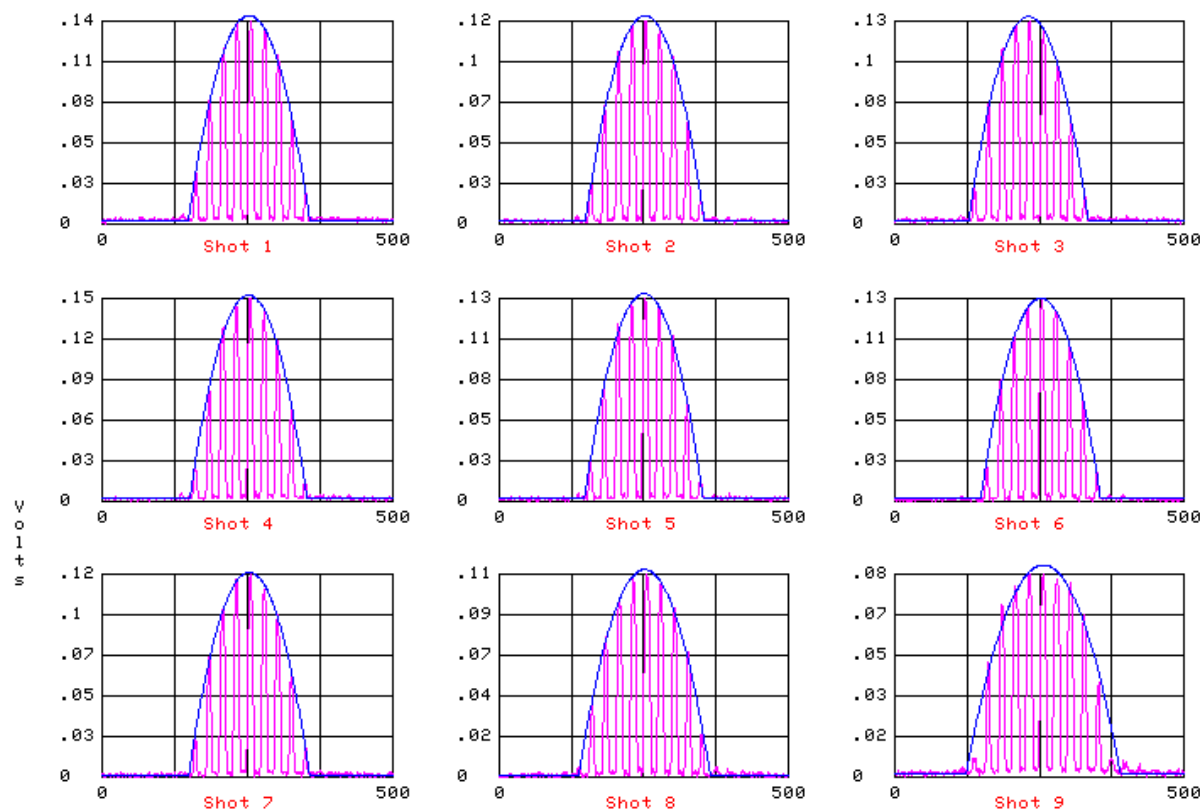


Longitudinal Emittance during Transfers to the Collider

Average Values for shots 1 thru 9:

Store 193 PBAR Longitudinal Emittance Displays Date: 03-DEC-01 07:16:57

Store 193



ARF-1 Volts:	38.8	kV
ARF-4 Volts:	834.8	Volts
2.5 MHz Emit:	1.54773	eV-sec
2.5 MHz Fit:	1.54057	eV-sec
53 MHz Emit:	1.19264	eV-sec
53 MHz Fit:	1.29041	eV-sec
Bunched Beam:	9.170	mA
53 Mhz BL:	11.212	nsec
Max Emit:	0.18612	eV-sec
2.5 MHz BL:	171.79	nsec
A:LONG4T:	0.752	eV-sec
A:LONG4E:	0.172	eV-sec

Shot 9 Values:

ARF-1 Volts:	39.2	kV
ARF-4 Volts:	829.5	Volts
2.5 MHz Emit:	2.25320	eV-sec
2.5 MHz Fit:	2.20844	eV-sec
53 MHz Emit:	1.77145	eV-sec
53 MHz Fit:	2.12995	eV-sec
Bunched Beam:	8.433	mA
53 Mhz BL:	12.893	nsec
Max Emit:	0.23128	eV-sec
2.5 MHz BL:	212.07	nsec
A:LONG4T:	1.042	eV-sec
A:LONG4E:	0.516	eV-sec



Future Plans

- Priority 1: Reduce transverse emittances for transfers at larger stacks
 - Core Cooling Upgrade
 - Find and remove heating sources
- Priority 2: Reduce Longitudinal emittance growth during transfers
 - Minimize transfer turn-around
 - Fix longitudinal mechanics of extraction
- Priority 3: Decrease cycle time of Pbar production cycles
 - Commission compensation legs in Stacktail
 - Make Debuncher momentum system work as designed
- Priority 4: Increase Pbar Production efficiency
 - AP2 and Debuncher Aperture
- Priority 5: Run 2B